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(54) Slicing machines for comestible products.

(57) A slicing machine (10) for comestible products has a reciprocally movable table (12, 12B) which delivers product to be cut to a slicing station (15) at which a slicing mechanism (16) is located, mechanism (16) comprises knife blade (20) rotatably mounted eccentrically on a counterbalanced rotatable carrier (21) and respectively powered by hydraulic motors (30, 31) which are operated by a hydraulic control system (28). Table (12, 12B) is driven by a hydraulic ram (32) operated by the control system (28) which incorporates a mechanism (38) for setting hydraulic fluid delivery pressure, the mechanism (38) incorporating pressure-setting valves (45, 46, 47) governed by solenoid-operated valves (43, 46) which are arranged such that when the temperature of the hydraulic fluid is below a nominal working temperature the delivery pressure established by the mechanism (38) is above a nominal working pressure and when the hydraulic fluid temperature reaches or exceeds the nominal working temperature the delivery pressure is established at the nominal working pressure and is rendered variable by valves (43, 46, 47) which are responsive to the rotational speed of the carrier (21) such that when carrier speed reduces working pressure is elevated above the nominal level.

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SLICING MACHINES FOR COMESTIBLE PRODUCTS

This invention relates to slicing machines for comestible products.

A known form of comestible product slicing machine particularly applicable to industrial use comprises a power-driven produce delivery device which is linearly movable towards a slicing station whereat slicing is effected by means of an orbital knife blade. The knife blade is rotatably driven about its own axis which is eccentrically mounted on a counterbalanced carrier, the carrier also being rotatably driven about its own axis. The motors which provide rotary motion of the knife blade and the counterbalanced carrier and the drive for the produce delivery device are hydraulically operated but the hydraulic system is relatively complicated and functions inefficiently when the machine is started and the hydraulic fluid is relatively cold. This results in inefficient product slicing until such time as the hydraulic fluid has attained its correct working temperature and the initially-cut slices of product may be unsaleable. In certain circumstances if the product to be sliced is particularly thick and/or tough the machine may stall caused by the combination of insufficient power in the slicing action of the knife blade and continued delivery of the product on the produce delivery device to the slicing station.

It is an object of the present invention to provide an improved form of comestible product slicing machine wherein the foregoing disadvantages are obviated or mitigated.

According to the present invention there is provided a slicing machine for comestible products comprising

a produce delivery device reciprocally movable towards and away from a slicing station and reciprocal drive means connected to said produce delivery device for

effecting reciprocal movement thereof,

a slicing mechanism located at said slicing station and comprising a rotatably-mounted knife blade and rotatable drive means connected to said blade for effecting rotation thereof,

wherein said reciprocal drive means and said rotatable drive means are each hydraulically operated by a hydraulic control system incorporating a mechanism for setting the hydraulic fluid delivery pressure, and means sensitive to the temperature of the hydraulic fluid for controlling said mechanism such that when the hydraulic fluid temperature is below a nominal working temperature the delivery pressure established by said mechanism is above a nominal working pressure.

Preferably said nominal working pressure is of the order of 80 bar and when the fluid temperature is below the nominal working temperature the pressure setting mechanism establishes a pressure of the order of 100 bar.

Conveniently when said temperature reaches or exceeds nominal said nominal working pressure is variable by means of said pressure setting mechanism in response to a speed sensor monitoring the rotational speed of said knife blade whereby said nominal working pressure is elevated in response to reduction of said rotational speed. By way of example the nominal working pressure may be elevated from 80 bar to 100 bar when the carrier speed reduces by 20 revs/min.

The knife blade of the slicing mechanism may be circular or involute in shape both constructions being known per se.

An embodiment of the present invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 pictorially illustrates a slicing machine according to the present invention,

Fig.2 illustrates the slicing mechanism and slicing station, and

Fig. 3 is a hydraulic circuit diagram.

The meat-product slicing machine 10 shown pictorially in Fig. 1 of the drawings comprises a support 11 on the upper surface 11A of which is located a reciprocal meat delivery device 12 which is arranged to deliver the product to be sliced to a slicing station 15 (shown more clearly in Fig. 2) at which there is located a slicing mechanism 16 protected by a generally circular housing 17. The support 11 is of box-like construction, floor-mounted, and houses the electrical and hydraulic components required to achieve operation of the machine, these components being accessible by means of a door 17A. A second door 17B houses a knife blade sharpener 18 (see Fig. 2) which is intermittently required as will be explained. Doors 17A, 17B may be otherwise located on support 11.

As shown in Fig. 2 the housing 17 is formed in two hinged parts and when the clasp 19 is released the housing parts can be released to permit access to the slicing mechanism 16. Mechanism 16 comprises a circular knife blade 20 eccentrically mounted on a counterbalanced carrier 21. The knife blade 20 is rotatably driven about its axis 20A by a chain drive within carrier 21 which for this purpose is partly hollow and carrier 21 is rotatably driven about its axis 21A. Both drives are provided by concentric shafts (not shown) co-axial with axis 21A driven by hydraulic motors (not shown). The arrangement is such that in station 15 there is a cutting edge 11B with which blade 20 co-operates to effect the product slicing action and housing 17 has cut-outs 17C to permit product to be delivered to edge 11B and cut product slices to be removed from the slicing station 15 by a conveyor mechanism (not shown) or other form of removal receptacle. Meat delivery device 12 comprises a fixed table 12A of

which edge 11B forms part, table 12A being adjustable by skilled service personnel to compensate for wear at edge 11B, and a gripper/pusher device 12B which is driven relative to table 12A by a hydraulic ram so that product to be sliced is continuously forwarded to edge 11B. To provide for uniformity of slice thickness the mechanism 16 is provided with a very small angular cant of axis 20A (of the order of 1 degree) so that edge 11B is slightly curved and protruding at one side which compensates for product movement during the slicing action.

Fig. 3 illustrates the hydraulic circuit 28 which is utilised to control operation of the power-driven components. Thus the hydraulic motor for driving the knife blade 20 is denoted 30, the hydraulic motor for driving the counterbalanced carrier 21 is denoted 31, and the hydraulic ram for driving the meat device 12B is denoted 32. The hydraulic circuit comprises a sump 33 into which used fluid is dumped and from which fluid is drawn by a gear pump 34 via a strainer 35, the output of pump 34 being delivered through a 10 micron filter and associated check valve 36 to a pressure-controlled manifold 37. Pressure control of manifold 37 is effected by control unit 38 as will be explained so that the pressure-controlled fluid is delivered at the output of manifold 37 to feed line 39 which delivers fluid to motors 30, 31 in parallel, motor 31 having a one-way check valve 40. Pump 34 is driven by electric motor 34A and unit 38 is provided with two parallel feeds 41, 42, the former being delivered to solenoid control valve 43 and the latter being delivered to solenoid control valve 44. Valve 44 is effectively OPEN/CLOSED having its output connected to sump 33 and is connected in parallel with relief valve 46 the output of which delivers to line 50 which is pressure controlled by relief valve 51 delivering to sump 33 via heat exchanger 52 and 10 micron filter 52A. Valve 43 is a three position valve delivering in its two

OPEN positions to one or other of two relief valves 45, 47 the output of each of which delivers to line 50.

The operation of control unit 38 is such that when valve 44 is in its OPEN position the fluid delivered by pump 34 is dumped directly to sump 33 and the pressure in manifold 37 is substantially zero. When valve 44 is in its CLOSED position the pressure in manifold 37 is governed by relief valve 46 which is set at approximately 100 bar provided valve 43 is in its CLOSED position. In accordance with the present invention valve 43 is held in its CLOSED position so long as the temperature of the hydraulic fluid in sump 33 is below a preset optimum level as measured by a thermistor sensor (not shown). When fluid temperature reaches and/or exceeds the nominal level the electrical interlocking of valve 43 is released and it is moved into either of its OPEN positions according to the position of meat table 12 and whether it is moving towards or away from cutting station 15. Valve 47 is set at approximately 80 bar whereas valve 45 is set at approximately 60 bar. When meat device 12B reaches its limit of movement away from station 15 and is signalled to move again towards station 15 valve 43 connects feed 41 to relief valve 47 (80 bar) whereas when device 12B reaches its limit of movement at station 15 and is ready to move again away from station 15 valve 43 connects feed 41 to relief valve 45 (60 bar). In any event the pressure pertaining in feed line 39 is determined by the lowest pressure setting of the operable one or ones of valves 45, 46, 47 and in each instance the pressure pertaining in line 50 is determined by relief valve 51 which is set at approximately 14 bar.

Line 50 delivers pressurised fluid (at 14 bar) to ram 32, which is double acting, via FORWARD/REVERSE solenoid valve 53 ram velocity being controlled in either direction by flow controller 54 whilst solenoid valve 55 functions as an ON/OFF controller insofar as movement of

meat device 12B towards station 15 is effected by pressurising the rear of the ram piston (valve 53 being in the position illustrated), reverse movement of device 12B away from station 15 being automatic.

Feed line 39 delivers pressurised fluid (at 100 bar or 80 bar or 60 bar) to motors 30, 31 in parallel, the respective rotational speeds of which are governed by flow controllers 60, 61 the outputs of which deliver to a three-position solenoid valve 59 having a single output connected to line 50. Valve 59 acts as a SINGLE MOTOR/STOP/DUAL MOTOR controller by virtue of the existence of check valve 58 and relief pressure valve 57. In its uppermost position valve 59 connects the line containing flow controller 60 to line 50 whilst the line containing flow controller 61 is blocked, pressure balance being achieved through relief valve 57. Accordingly in this position knife blade 20 is rotated but carrier 21 is held stationary and this position is used for sharpening of blade 20 by means of sharpener 18 which is manually affixed to carrier 21 as illustrated in Fig. 2. Removal of sharpener 18 from its holder within doorway 17B activates a microswitch which signals valve 59 to this position uniquely. Rotational speed of motor 30 in this condition is governed by flow controller 56 which, of course, is set at a lower level than controller 60 since for sharpening purposes the speed of knife blade 20 is only of the order of a few revs/min. whereas for cutting purposes this speed is of the order of several hundred revs/min. In its central position valve 59 blocks both lines from motors 30, 31 pressure balance for each being achieved via relief valve 57 if so required (as will be explained). In its lowermost position valve 59 connects the line containing controller 61 to line 50 whilst the line containing controller 60 is blocked but flow of fluid is maintained via check valve 58 so that both motors 30, 31 are operational.

Lubrication fluid in motors 30, 31 is provided by the feed 39 and this fluid is drained to sump by drain line 48.

Electrical control of the various solenoids is effective as follows. When the hydraulic fluid temperature is less than a preset nominal value solenoid valve 43 is electrically interlocked in its central CLOSED position so that relief valves 45, 47 are non-operational and normal slicing operation of the machine 10 ensues with valve 44 in its CLOSED position. If the machine 10 requires to be manually powered down this is effected by activation of an ON/OFF button (not shown) which moves valve 44 to its OPEN position and at a fixed time interval thereafter (for example 4 seconds) pump motor 34A is de-energised. If an emergency stop condition arises as determined by any one of the numerous sensors associated with the machine 10 in the interests of operator safety motor 34A is de-energised simultaneously with valve 44 being moved to its OPEN position. In either event cavitation of the hydraulic fluid in the hydraulic system is prevented by a check valve 49 interconnecting lines 50 and 39. When nominal fluid temperature is reached and/or exceeded valve 43 is disinhibited and is signalled into one or other of its OPEN positions as previously explained by the movement of the meat table 12 such that when the device 12B is moving towards station 15 relief valve 47 is operable to provide 80 bar pressure in line 39 but when device 12B moves away from station 15 relief valve 45 is operable to provide 60 bar pressure in line 39. In a further control mode the rotational speed of carrier 21 is monitored by a proximity detector and in the event that the carrier rotational speed drops by a predetermined amount (for example 80 revs/min) with relief valve 47 operable solenoid valve 43 is moved to its central position in order to render relief valve 46 operational at 100 bar. This event may occur when the product being

sliced is unexpectedly tough.

It will now be appreciated that the hydraulic system described is relatively simple in concept and facilitates the use of standard off-the-shelf components namely flow controllers, two position solenoid valves, three position solenoid valves and relief valves so that the system may be rendered modular if so desired. The associated electrical control system if so desired may also be modular and embodied in hard-wired logic elements or soft-ware logic (i.e. microprocessor). The system is advantageous in that the slicing power is controlled so that commercially acceptable slicing can be effected immediately from start-up of the machine.

CLAIMS

1. A slicing machine for comestible products comprising a produce delivery device (12B) reciprocally movable towards and away from a slicing station (15) and reciprocal drive means (32) connected to said produce delivery device (12B) for effecting reciprocal movement thereof, a slicing mechanism (16) located at said slicing station (15) and comprising a rotatably-mounted knife blade (20) and rotatable drive means (30,31) connected to said blade (20) for effecting rotation thereof

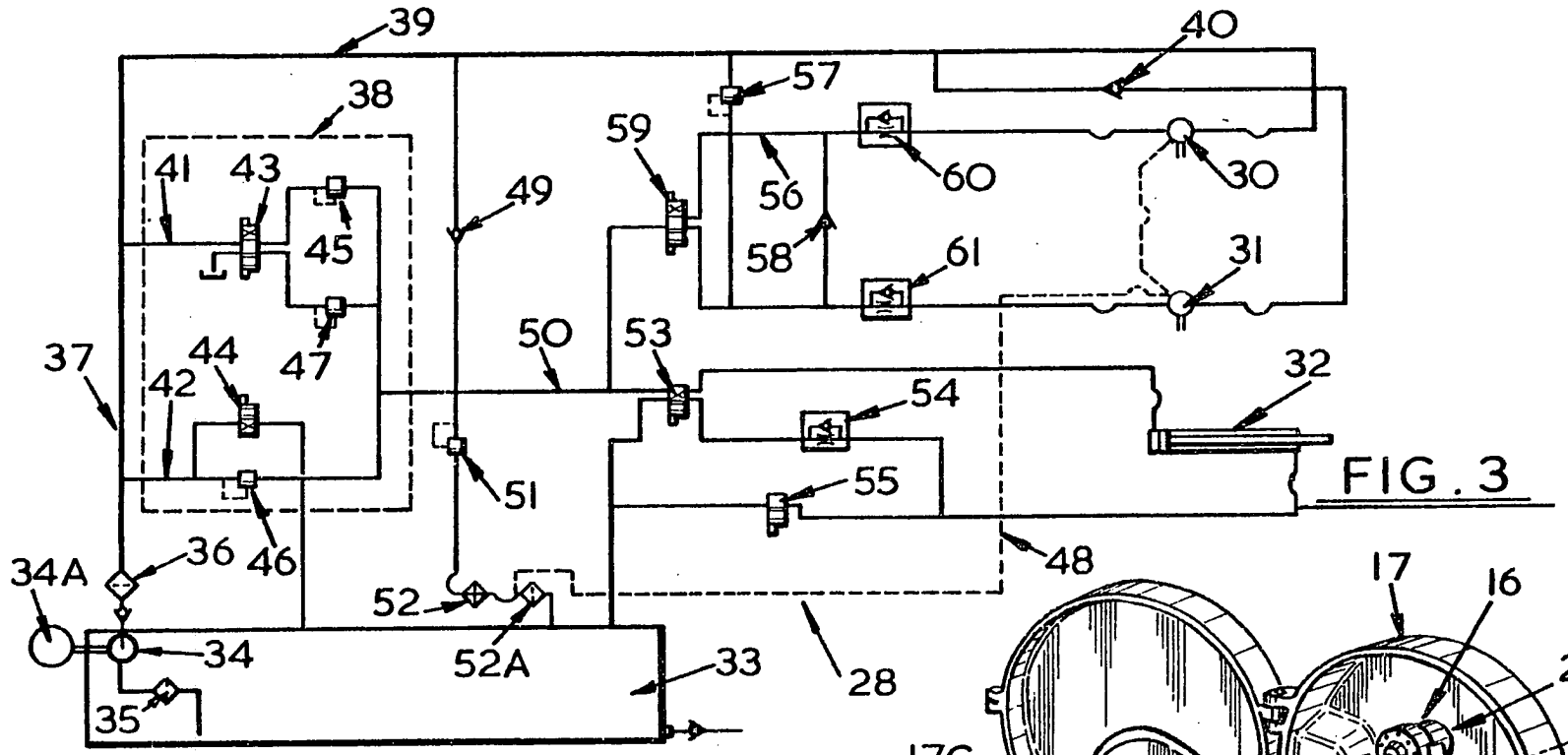
characterised in that said reciprocal drive means (32) and said rotatable drive means (30,31) are each hydraulically operated by a hydraulic control system (28) incorporating a mechanism (38) for setting the hydraulic fluid delivery pressure, and means (43) sensitive to the temperature of the hydraulic fluid is provided for controlling said mechanism (38) such that when the hydraulic fluid temperature is below a nominal working temperature the delivery pressure established by said mechanism (38) is above a nominal working pressure.

2. A slicing machine as claimed in claim 1, characterised in that when said hydraulic fluid temperature reaches or exceeds nominal said nominal working pressure is rendered variable by means (43,46,47) forming part of said mechanism (38) and responsive to the rotational speed of said knife blade (20) such that said nominal working pressure is elevated in response to reduction of said rotational speed.

3. A slicing machine as claimed in either preceding claim, characterised in that said knife blade (20) is rotatably mounted on a counterbalanced rotatable carrier (21) and said rotatable drive means (30,31) is connected to said carrier (21) and said blade (20) for effecting rotation thereof and comprises first (30) and second (31) hydraulic motors hydraulically driven in parallel from

said mechanism (38), the hydraulic outputs of said motors (30,31) being connected to means (59) for selecting drive of one or both motors or stop for both motors.

4. A slicing machine as claimed in claim 3, characterised in that the hydraulic control system (28) has the circuit set forth in Fig. 3 of the accompanying drawing.



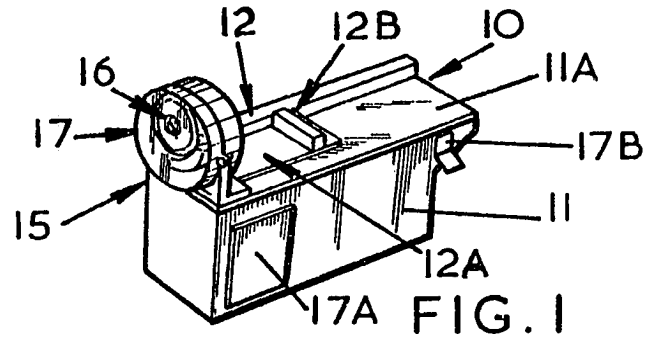


FIG. 1

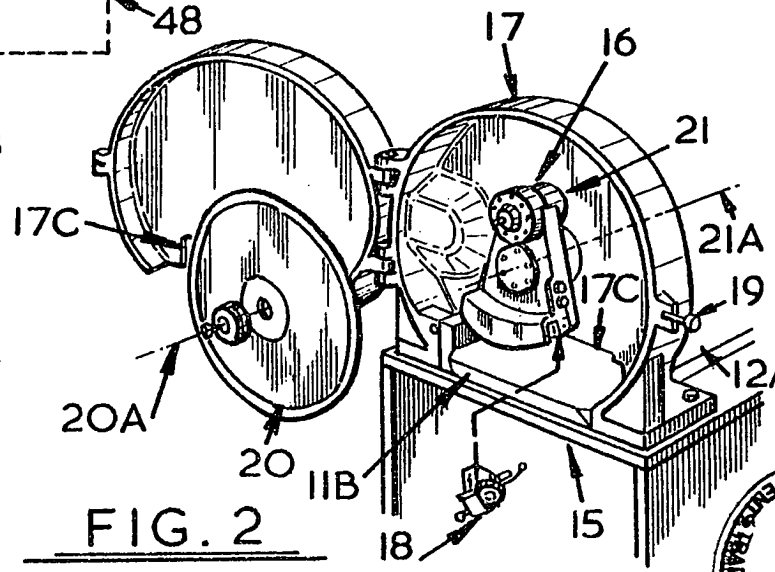


FIG. 2